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mHEALTH

Putting Healthcare Transformation on Steroids

By Debra Gordon, MS; Colin Korschak, MBA, FHIMSS; David Levin, MD and William H. Morris, MD

ABSTRACT

Mobile health is poised to become a major driver and accelerant of the transformation of health care from a volume-based system to a value-based system. This tsunami of change is being driven by a perfect storm of out-of-control healthcare costs and the availability of faster, cheaper, more reliable, interoperable technology, particularly that available through cellular phones, tablets, and other wireless communication devices.

As the cost of this technology continues to fall, it has become available to even the poorest people in the most remote parts of the globe. The end result is a global industry expected to reach \$26 billion in revenues by 2017. Indeed, industry analysts predict that the growth of mHealth in the near future will rival that of the Internet in the 1990s.

mHealth applications have significant relevance in numerous areas of healthcare reform, including the potential to reduce costs by lowering complication rates, emergency department visits, and hospital admissions; improve quality through better tracking and preventive care; and enhance patient involvement and engagement.

However, several daunting challenges face mHealth, particularly privacy and security. Overcoming those barriers is critical if mHealth is to reach its full potential.

KEYWORDS

mHealth, global, telehealth, mobile health, quality, digital, cost, value-based care.

BANKING, AIRLINES, transportation, shopping. All have been dramatically transformed by mobile technology and wireless communication in the past five years, with paradigm shifts in how businesses and customers interact and, indeed, how they do business overall.

Not so in healthcare. Although medicine, with its powerful imaging machines, robotic surgeons, and electronic monitors and devices, is, arguably, one of the most technology-heavy industries in the world, it lags far behind when it comes to harnessing the power of technology to enhance the patient experience; track and improve quality; and manage and reduce costs. It is still one of the few industries in which data is more likely to be transmitted via fax machine than computer; where records are filed on metal shelves rather than in the cloud; and where the end user—the patient—is often treated as an afterthought rather than the center of the process.¹

Although the 2009 Health Information Technology for Economic and Clinical Health (HITECH) Act was designed to address some of these shortcomings via support for electronic health records (EHR), the rollout of EHRs that do more than just collect data has been slow.² Even if 100 percent of healthcare entities were meeting all components of Stage 2 Mean-

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ingful Use requirements for EHRs, however, it would still would not come close to addressing the foundational problems of our healthcare system: out-of-control costs, poor quality, and disengaged patients.

However, if we incorporate the EHR into a comprehensive suite of technological approaches—most available remotely with nothing more complex than a smartphone or tablet—then the possibility of substantive progress on these challenging issues becomes a reality.

We have spent the past year researching and writing a book about the potential of mobile health as a major driver and accelerant of the transformation of health care from a volume-based system to a value-based system. Our work has convinced us that coupling mHealth to the twin engines of the EHR and healthcare reform is vital if we are to experience the kind of fundamental changes in healthcare delivery required in the United States and other countries. It is also, we are certain, the only way to deliver healthcare in the developing world, where there may be a single doctor for 10,000 people, and where the majority of medical services are provided not by physicians or nurses, but by community health workers with little access to transportation, electricity, or hospitals.

As the paradigm shifts, it will require a tremendous infusion of information and

education untethered from a single place or even to the provider. These mobile technologies, the Institute of Medicine wrote in its 2012 report, *Best Care at Lower Cost*, have the potential to substantially change the way healthcare is delivered and consumed.¹

mHEALTH DEFINED

While there are many definitions of mHealth, we define it as any technology—software or hardware—that enables providers, payers, and patients to provide and receive medical treatment and information, as well as monitor their own health, regardless of place or time. At its core, mHealth is a new way of interacting with patients (and a new way for patients to interact with us) that is divorced from the traditional “four-walls-and-an-examining-table” model. It is a way to remove time and space as barriers to healthcare.

We call it “Pervasive Health Information Technology,” or pHIT (pronounced “fit”), a phrase we created to describe the devices, sensors, and data integration that will soon be pervasive throughout health care and that will fundamentally reshape the way such care is delivered.

Indeed, industry analysts predict that the growth of mHealth in the near future will rival that of the Internet in the 1990s. Estimates are that the mHealth industry will reach 26 billion in revenues by 2017.^{3,4}

Between 2010 and 2015, experts predict the industry will have grown between 12 percent and 16 percent.⁵ As of mid-2012, according to a *Medicine on the Net* article, the US Food and Drug Administration estimated that there were more than 17,000 health and fitness apps available as well as nearly 15,000 medical apps—most of which are being downloaded and used with little or no-regulatory oversight or vetting.⁶

The significant potential of mHealth and its explosive growth, however, may be tempered by potential pitfalls and barriers, including privacy and security, funding, and oversight, all addressed later in this article.

mHEALTH FOR PATIENT ENGAGEMENT

Two reports from the Institute of Medicine in the past 12 years highlighted the importance of patient centeredness in improving healthcare.^{4,7} Numerous studies find that engaged patients tend to be healthier, are more likely to adhere to their medication and treatment plans, to keep appointments, and to take responsibility for their own health.⁸ Unfortunately, numerous barriers remain when it comes to shared decision making and patient engagement.^{9,10} mHealth can help overcome those barriers by putting information in the patients’ hands via cell phones and tablets, and making it easier for two-way communication

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with and between clinicians.

A 2012 poll from Wolters Kluwer Health found that 80 percent of the 1,000 adults surveyed were ready to make their own healthcare decisions, including researching treatment options. Consumers also told pollsters that they felt more empowered and better about the quality of care they receive when they take a more active role.¹¹

Many also said they were more likely to choose physicians that allowed them to communicate via email, schedule appointments online, and use mobile devices or computers during office visits.¹¹

Meanwhile, a 2012 study from The Economist Intelligence Unit and the consulting firm PwC found that in the next three years about half of consumers expect mHealth to change how they seek information on health issues, receive general healthcare information from providers, manage their overall health, chronic conditions, and medication, communicate with their healthcare providers, and measure and share their vital health information.³

These are all important components of patient-centered medical homes and accountable care organizations—new models of healthcare delivery designed to put the patient and clinical outcomes at the center. Neither, we believe, will be successful without the significant use of mobile technology ranging from patient-

facing smartphone and tablet applications, to remote access to the EHR and personal health record (PHR), to digital monitoring of chronic conditions like diabetes and congestive heart failure.

None of these elements should operate in a vacuum. Instead, they must be integrated into a simple-to-use suite of applications. For instance, a high blood glucose value entered into a smartphone app would trigger immediate feedback to the patient. That feedback may include a link to the EHR so the patient can schedule an appointment electronically, as well as recommendations regarding medication, nutritional, and physical activity changes. At the same time, the alert is sent into the EHR, where it is run through an algorithm and, if necessary, transferred to a healthcare provider for follow up. Do this for thousands of patients at once and you have a new paradigm for population health management.

The goals are to empower patients, provide effective, continuous care—especially during transitions of care—and to integrate the app into the workflow and data streams of the care team. So prescription refills are sent from the app to the doctor and pharmacy; appointment reminders are pushed through the app; lab results appear automatically; sensors that track the heart rate when they run or blood glucose levels if they have diabetes automatically feed

that data into the app and back and forth between the app and the rest of the health IT ecosystem.

Consumers aren't waiting around for their doctors to invite them to play in the mHealth sandbox. They're downloading thousands of apps to help them do everything from track their calories, identify suspicious moles, and monitor their blood glucose and heart rates. Indeed, iTunes currently offers more than 12,000 health-related applications, while a Google search on mobile healthcare in late 2012 brought up 1.67 million results. Compare that to 5,000 hits in 2007.^{12,13}

mHEALTH DRIVER: COST AND QUALITY

In 2012, it cost more than \$20,000 to provide health care for the average insured family in the US—a nearly 7 percent increase over 2011 and more than triple the inflation rate. [14] By 2021, health care will make up nearly one-fifth of the gross domestic product, a 9.5 percent increase from 17.9 percent in 2009. Yet, as the Institute of Medicine noted in 2012, "American health care is falling short on basic dimensions of quality, outcomes, costs, and equity." For instance, studies find that as many as one-third of hospitalized patients may be harmed or experience some type of adverse event from preventable errors.¹

This kind of spending for this level of

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quality is unsustainable, particularly given the aging population we and other Western countries face.

Health reform is designed to address these issues, in part by shifting from a fee-for-service reimbursement model to a value-based model that ties payments to quality indicators such as readmission rates, hospital-acquired infections, and medication adherence rates.

Being paid to care for a population over time—rather than for each episode of care—creates greater incentives for providers to focus more on prevention and wellness, as well as identify opportunities to reduce hospitalizations, hospital-related infections, and exacerbations of chronic conditions such as diabetes and chronic obstructive pulmonary disease (COPD). This, in turn, requires a proactive approach to health and access to real-time data, such as daily glucose levels for diabetes patients and lung function results from those with COPD or asthma.

To meet these changing goals, healthcare entities are turning to digital technology, particularly mHealth, to better assess, track, and manage today's complex patients while improving quality and reducing cost. It can make a difference, with studies finding that:

- Remotely monitoring heart failure patients after discharge led to a 6 percent

readmission rate compared to the 47 percent national average.¹⁵

- Remotely monitoring fetal heart rates in women with high-risk pregnancies reduced hospitalizations and outpatient visits.¹⁶

- Using digital cameras to document pressure sores in patients and transmitting the images to specialists for remote consultations reduced emergency room visits and hospitalizations.¹⁷

- Using telehealth to monitor people with diabetes, COPD, or heart failure for a year led to an 18 percent drop in emergency hospital admissions, a 44 percent drop in deaths, and shorter hospital stays, with no increase in costs.¹⁸

- Using remote postsurgical pulse oximetry monitoring saved one hospital an estimated \$1.4 million on one floor alone by reducing complications, rescue events, transfers to the intensive care unit, length of stay, and readmissions.¹⁹

University of Oxford Professor Lionel Tarassenko estimated that mHealth could save Great Britain's National Health Service £750 million (\$1.1 billion) a year by reducing hospital admissions,²⁰ while Juniper Research's 2010 Mobile Health Opportunities Report estimated that just the use of remote patient monitoring via cell networks could save between \$1.96 billion and \$5.83 billion in healthcare costs by 2014,

most of that in the US and Canada.²¹

The consulting firm Accenture predicted in 2012 that mobile solutions could save the US more than \$23 billion a year by targeting patients with chronic diseases primarily by reducing hospital days and emergency room visits and improving outcomes.²²

We suspect that payers and providers won't fully embrace the cost-savings potential of mHealth until we move further along the road of value-based purchasing. At that point, healthcare providers will be more inclined to purchase tablets for patients with chronic diseases and load them with an integrated suite of apps to help patients better control their disease and communicate with clinicians. Based on pilot programs using such an approach, we can expect improved outcomes at lower costs.²³⁻²⁵

mHealth also has a role to play in reducing the waste in our healthcare system, estimated at \$765 billion a year, and providing greater access to real time clinical information.¹

But can we get clinicians to use the technology for these purposes? Unfortunately, a recent survey from Clearwater, Fla.-based researcher company Black Book Rankings found that most primary care physicians used their cell phones to communicate with staff, while about half used tablets for medical reference and research, Just 8 percent of

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those surveyed said they used their mobile device for electronic prescribing, ordering tests or viewing their results, or accessing the EHR, while less than 1 percent told surveyors that they were fully tapping the potential of their mobile technology when it came to patient care.²⁶

Yet nearly all of the physicians surveyed said they wanted an EHR system that could be accessed through mobile devices. They just didn't have one.²⁶

Vendors *are* responding, with Black Book reporting that 122 EHR companies surveyed said they would introduce fully functional mobile access and/or iPad native versions of their products by the end of 2013, with another 135 developing such apps.²⁶

Black Book polling also found that the most requested features for mobile EHRs were the ability to remotely review and update charts, view schedules and appointments, send messages to staff, order labs and review results, permit electronic prescribing and patient encounter documentation, input vital signs, and access EHR data after office hours.²⁶

Another survey of 1,400 clinicians found a strong preference for tablets when it comes to accessing EHRs. Although just half of the clinicians surveyed said they used their tablet to access the EHR, that figure plummeted to 7 percent for smartphones. Even so, the survey found, just a third of smartphone users and 18 percent of tablet users said they were "very satisfied" with the quality of apps for their profession.²⁷

Clearly, the quality of mobile solutions on the provider side, particularly those that can be easily integrated into the daily workflow, is lacking.

mHEALTH FROM THE PAYER PERSPECTIVE

Payers are well aware of the potential cost savings of mHealth, and are rapidly developing and implementing their own solutions. One major area is telehealth.

In 2012, the Veterans Administration announced it would waive patient copayments for in-home video telemonitoring as an incentive to increase the use of such

technology.²⁸ Several health insurers, including WellPoint, Aetna, and Humana, are piloting payment programs for remote monitoring to cut readmissions.²⁹

Partners HealthCare in Boston found such a program slashed heart failure-related readmissions by half and non-heart failure readmissions by 44 percent among the 1,200 patients enrolled. The program has saved the insurer more than \$10 million since 2006, or about \$8,000 per patient.³⁰

Large insurers have also rolled out apps for their members that enable them to find a local doctor, view their personal health record, learn about their coverage and benefits, use their GPS to locate the nearest urgent care center (with turn-by-turn directions and wait times), and even use their phone as their identification card.

Meanwhile, UnitedHealthcare developed a cost estimator that lets members shop for more than 100 services based on cost and quality in nearly 50 markets. It creates side-by-side comparisons between facilities that are based on contracted fees with provider, and identifies alternative treatment options so patients can have an "informed conversation" with their doctor.³¹ This marks an important step on the road towards cost and quality transparency, an important goal of healthcare reform.

mHEALTH: GOING GLOBAL

One third of the world's poorest people, about 1 billion individuals, have no access to a healthcare system. At least, not the kind of system we think of when we think of health care in the developed world. In these countries, the most important element of the medical system is not a doctor or a hospital, but a cell phone.

While there are 11 hospital beds and 305 computers for every 5,000 people in the developing world, there are 2,293 mobile phones.³² Overall, the mobile phone penetration rate is 89 percent per 100 people, with 5.2 billion subscriptions. The penetration rate in developed nations is 128 percent, with 1.6 billion subscriptions.³³

China and India top the list of countries with the highest number of mobile subscriptions in the world. Indonesia, Pakistan, and Nigeria also among the top 10.³³

Of all developing regions, sub-Saharan Africa has the fastest mobile growth rate in the world. In 2000, just 1 percent of residents there owned a mobile phone. By 2012, that percentage had jumped to 54 percent.³⁴

Thus, it is not surprising that people in the developing world are more aware of the term "mobile health," than those in developed countries, and are more likely to use an mHealth application or service. Their doctors are even more likely to offer mHealth services.³

These countries are building nascent healthcare systems in the same way they built their telecommunications system—bypassing the traditional bricks-and-mortar approach (and copper wires and land lines) and going straight to wireless digital. For health care, that means telemedicine, texting, and remote care for some of the regions' most pressing health-related issues, including:

- **Maternal/child health.** A review of 34 articles published in the *Maternal Child Health Journal* found that mHealth helps reduce the maternal and neonatal death rate just by minimizing the time it takes for a mother or infant to receive urgent care.³⁵

One of the largest such initiatives is the Mobile Alliance for Maternal Action (MAMA). Women provide their due date or the birth date of their youngest child and then receive free weekly messages and reminders for the rest of their pregnancy and the first year of the baby's life. These include information on nutrition, breastfeeding, newborn care, immunizations, and more.³⁶

Smaller initiatives include programs like the Wired Mothers project in Zanzibar, in which pregnant women receive text messages about health education, prenatal visits, the importance of having a healthcare worker at the delivery, and information about postnatal care. The messages are customized based on the woman's gestational age throughout the pregnancy. A study of the program found that 60 percent of women in the intervention group versus 47 percent of controls delivered with skilled attendance, significantly more women had

WHEN A MATERNITY hospital in South Africa sent text reminders to HIV-positive mothers to get their infants tested, 74 percent of mothers took their babies in at 6 weeks for testing versus 58 percent before the program.

more than one prenatal visit, complication rates in the intervention group were 7.5 percent versus 11.5 percent in the control group, and maternal morbidity among the intervention group fell from nearly 500 per 100,000 live births to just under 300 within 4 years.^{37,38}

- **Immunization rates.** Seventy percent of children who do not receive the 3 most basic vaccines during their first year of life—diphtheria, tetanus, and pertussis—live in the developing world.³⁹ Increasing vaccine coverage just 8 percent from the 2009 levels of 82 percent, the World Health Organization estimates, would save an estimated 2 million lives a year.⁴⁰

mHealth can help. For instance, texting immunization reminders to mothers in Kenya significantly increased vaccination rates compared to a control group, while a similar program in Bangladesh led to an 85 percent increase in immunization rates in just 1 year.^{41,42}

- **HIV/AIDS.** mHealth also has an important role to play in the prevention and treatment of HIV in the developing world, where the epidemic continues to rage. While 69 percent of people living with HIV/AIDS are in sub-Saharan Africa, just 40 percent who need treatment get it, in large part because they aren't tested or aren't educated about the disease and the need for treatment.^{43,44}

Something as simple as texting can help. In a Ugandan program, texting

information about the disease and the locations of testing centers to 15,000 mobile subscribers resulted in a 40 percent increase in the number of people getting tested in just 6 weeks.³²

When a maternity hospital in South Africa sent text reminders to HIV-positive mothers to get their infants tested, 74 percent of mothers took their babies in at 6 weeks for testing versus 58 percent before the program.⁴⁵ Similar programs are underway to improve treatment adherence and encourage the use of condoms and other safe sex approaches.^{46,47}

FACING THE CHALLENGES TO mHEALTH

While the potential of mHealth to improve access, quality, outcomes, and cost in health care systems throughout the world is tremendous, numerous challenges and barriers exist. Chief among them are privacy and security, particularly in the United States.

Barely a day goes by without a report of compromised electronic health records, whether from hackers or lost or stolen laptops or cell phones.⁴⁸⁻⁵¹ This is an issue that will only become more common as more patient data is stored in the cloud and remote access to EHRs become the norm. It doesn't take much to hack into these records: auditors from the US Office of Inspector General of the Department of Health and Human Services obtained patient information from unsecured hospital wireless networks while sitting in a hospital parking lot with a laptop.⁵²

But mobile EHRs aren't the only health-care-related data at risk. Think about all the devices patients wear or have implanted in them that communicate remotely with monitors and computers, as well as health-care entities' increasing reliance on digital technology for everything from setting appointments to performing MRIs.

The risks are real. Between 2009 and 2011, the Veteran's Administration (VA) reported 173 incidents of security breaches that disrupted glucose monitors, canceled patient appointments, and shut down sleep labs.⁵³

At Cleveland Clinic, the IT team is addressing these risks through multiple and redundant layers of security. For instance, just putting the word "Confidential" in the subject line of an email automatically encrypts that email. The challenge is getting our staff to type in the word.

In 2012, the Clinic installed sophisticated anti-virus/malware software called FireEye, which blocks cyber attacks in real time. They were surprised to find that despite best efforts, 180 of our computers were infected with malware, and that hackers try to infiltrate the system 20 to 40 times a week.

That is why it is so important that we think beyond HIPAA-related patient privacy and consider the life-and-death risks of someone hacking into an implanted insulin pump or defibrillator. It is important that we understand that if a device can send data *out*, someone can send data *in*,

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potentially compromising the integrity of the information and patient safety.

For instance, a presenter at the Breakpoint 2012 Security Conference in Australia, a premier meeting for security information technology experts, showed how someone with a laptop standing 50 feet away could deliver a fatal, 830-volt shock to a pacemaker patient.⁵⁴ In Las Vegas in 2011, 100 hackers at the DEFCON 19 conference learned to attack MRI and CT scanners.

A 2012 report from the General Accounting Office found the threat of malicious interventions to implantable wireless devices so significant that it recommended the FDA develop a plan to address them. The report noted that the FDA had never considered security risks from intentional threats until it saw an early draft of the report.⁵⁵

Healthcare entities appear unaware of the risks. A survey of 80 healthcare organizations found that 69 percent did not secure their medical devices, possibly because they think it is the vendor's responsibility. The reality is that if a privacy breach occurs, both the vendor and the healthcare entity are responsible—and both face steep HIPAA fines as well as other liability.⁵⁶

One problem with device security is that the FDA does not require encryption for medical devices and adding such safeguards post-approval would require manufacturers to resubmit their devices for approval.

Another challenge to the use of mHealth, particularly applications, is the quality of the apps. The FDA has promised regulations regarding which apps require agency approval later this year. In the meantime, at least one service has stepped into the vacuum with its own standards for testing and certifying mobile health apps, and medical journals are beginning to assess the safety, quality, and efficacy of mobile apps.^{57,58}

CONCLUSION

The healthcare industry is finally catching up to other industries in its implementation and use of mobile technology after years of trailing far behind. The effort is driven in large part by the perfect storm of double-digit healthcare cost increases, tightening

budgets, increasing rates of chronic disease, and the need for improved quality and outcomes in the delivery of healthcare.

With the right technology and training, we can deliver quality health care remotely from or to anywhere. We can learn instantaneously if a heart failure patient is at risk of decompensating and requiring a hospital admission. We can put more information into the hands of our patients using the one tool nearly all of them have—a cell phone. And we can teach them to use that cell phone to make better choices in their lifestyle and as part of their medical care.

In developed countries like the US, the promise of mHealth lies in its ability to tackle our toughest challenges—cost and quality. But in the developing world, the promise of mHealth is far greater—the ability to provide a health care system in countries that often lack even the most basic of services.

While mHealth may appear far removed from the examining room or the surgical suite, we believe that its potential for transforming the health care system is just as great as the changes wrought over the past century by innovations such as hygiene, vaccines, and antibiotics. **JHIM**

Parts of this article were excerpted from the forthcoming book, "mHealth: Global Opportunities and Challenges," which is being published by Convergence Publishing in late 2013.

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